STATUTORY DECLARATION

I, Kyung Gu KANG, a citizen of the Republic of Korea and a staff member of Y.H.KIM INTERNATIONAL PATENT & LAW OFFICE specializing in "BACK LIGHT UNIT AND LIQUID CRYSTAL DISPLAY USING THE SAME" do hereby declare that:

I am conversant with the English and Korean languages and a competent translator thereof.

To the best of my knowledge and belief, the following is a true and correct translation of the Relativity Document (No. P2002-58725) in the Korean language already filed with Korean Industrial Property Office on September 27, 2002.

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Kyung Gu KANG

PATENT APPLICATION

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TITLE OF THE INVENTION: BACK LIGHT UNIT AND LIQUID CRYSTAL DISPLAY USING THE SAME

APPLICANT(S): LG. Philips LCD Co., Ltd.

ATTORNEY(S)

Young Ho KIM

INVENTOR(S)

Name: Seung Jun HAN

Address: #202-707, Woobangsincheonji Town, Namyul-ri, Seokjeok-myun, Chilgok-gun, Kyoungsangbuk-do, Korea

Nationality: Republic of Korea

Name: Seung Hyun YUN

Address: #202-120, Sannam Jugong APT., Sugok-dong, Heungduck-ku, Chungju-shi, Chungcheongbuk-do, Korea

Nationality: Republic of Korea

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Patent Attorney

Young Ho KIM

[ABSTRACTS]

[ABSTRACT]

The present invention relates to a back light unit and a liquid crystal display using the same for improving brightness characteristic and difference of the color sense of a liquid crystal display having a direct-below-type back light.

The back light unit and the liquid crystal display using the same according to an embodiment of the present invention includes a lamp housing, and a plurality of lamps respectively having a first electrode and a second electrode and arranged in the lamp housing so that the first electrode and the second electrode are alternately disposed in one side of the lamp housing.

The present invention improves the brightness and minimizes right/left difference of the color sense, so that it becomes possible to improve picture quality.

[REPRESENTATIVE DRAWING]

Fig. 5

[SPECIFICATION]

[TITLE OF THE INVENTION]

BACK LIGHT UNIT AND LIQUID CRYSTAL DISPLAY USING THE SAME

[BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1 is a sectional view schematically illustrating a liquid crystal display using a related art direct-below-type back light unit;

Fig. 2 is a plan view illustrating arrangement of lamps shown in Fig. 1;

Fig. 3 is a sectional view illustrating a method spreading phosphor within lamps shown in Fig. 1;

Fig. 4 is a sectional view illustrating a back light unit according to an embodiment of the present invention;

Fig. 5 is a plan view illustrating arrangement of lamps shown in Fig. 4;

Fig. 6 is a diagram illustrating a brightness distribution of back light unit of the present invention and a related art back light unit;

Fig. 7A is a diagram illustrating a difference of a color sense of the related art back light unit;

Fig. 7B is a diagram illustrating a difference of a color sense of a back light unit of the present invention;

Fig. 8 is a plan view illustrating another arrangement

of lamps shown in Fig. 4; and

Fig. 9 is a sectional view illustrating a liquid crystal display using the back light unit according to an embodiment of the present invention.

<DETAILED DESCRIPTION OF THE REFERENCE NUMERALS>

2, 102: back light unit 10, 110, 210: lamp housing

12, 112, 212: lamp 14, 114, 214: diffusion plate

16, 116, 216: optical sheets

20, 120, 220: liquid crystal panel

22, 122, 222: upper substrate 24, 124, 224: lower substrate

30: vessel 32: organic solvent

34: lamp bulb 36: vacuum pad

38: phosphor

[DETAILED DESCRIPTION OF THE INVENTION]

[OBJECT OF THE INVENTION]

[TECHNICAL FIELD INCLUDING THE INVENTION AND PRIOR ART THEREIN]

The present invention relates to a liquid crystal display, and more particularly to a back light unit for improving a brightness and a difference of the color sense of a liquid crystal display having a direct-below-type back light and a liquid crystal display using the same.

In general, a liquid crystal display (hereinafter referred to as "LCD") has a characteristic of lightness, thinness, and low-power-consumption driving and thus its application scope has been widened. The LCD is used in an office automation machine and an audio/video machine in accordance with such a trend. The LCD adjusts transmitting quantity of light beam in accordance with image signal applied to a plurality of control switches arranged in a matrix shape to thereby display desired pictures in a screen.

Since the LCD is not a spontaneous display apparatus, it needs a light source such as a back light. The back light for LCD has a two types such as a direct-below-type method and a light guide plate method. The direct-below-type back light has several phosphor lamps in a plane. Further direct-below-type back light has a diffusion plate installed between phosphor lamp disposed and liquid crystal panel to thereby constantly maintain a gap between liquid crystal panel and diffusion plate. The light guide plate back light has a phosphor lamp installed in an outside of the plate so that light is incident to whole surface of a liquid crystal panel by using a transparent light guide plate from the phosphor lamp.

Referring to Fig. 1, the LCD using the direct-below-type back light of a related art includes a liquid crystal panel 20

for displaying pictures and a back light unit 2 for uniformly radiating light to the liquid crystal panel 20.

The liquid crystal cells are arranged in active matrix shape between upper and lower substrates 22 and 24 of the liquid crystal panel 20. Pixel electrodes and common electrodes are installed to apply electric field for each liquid crystal cell. In general, while the pixel electrode is formed for each liquid crystal cell on the lower substrate 24, that is, on the thin film transistor substrate, the common electrode is integrally formed in one body on whole surface of the upper substrate 22. Each of the pixel electrodes is connected to a thin film transistor used as a switch device. The pixel electrode drives the liquid crystal cell along with the common electrode in accordance with data signal supplied through thin film transistor to thereby display pictures corresponding to video signal.

The back light unit 2 includes a plurality of lamps 12 generating light, a lamp housing located in the lower part of the plurality of lamps 12 (or a lamp container 10 of the direct-below-type back light unit 2), a diffusion plate 14 located in the upper part of the plurality of lamps 12, and optical sheets 16 located on the diffusion plate 14.

Each of the lamps 12 is comprised of a glass tube, an inert gas in the glass tube, and a cathode and an anode

installed at ends of the glass tube. The inert gas is filled up in the glass tube, and a phosphor is coated at the inner wall of the glass tube.

In the lamps 12, if AC voltage from the inverter (not shown) is applied to a high-pressure electrode (or a first envelope part H) and a low-pressure electrode (or a second envelope part L), electrons are emitted from the low-pressure electrode L and are collided with the inert gas in the glass tube whereby the quantity of electrons is increased exponentially. The current flows in the glass tube by the increased electrons, the inert gas is exited by the electrons and thus ultraviolet rays are emitted. The ultraviolet rays are collided with the phosphor and mercury coated at the inner wall of the glass tube to thereby emit visible rays.

The lamps 12 are arranged in parallel on the lamp housing 10. As shown in Fig. 2, the lamps 12 are arranged on the lamp housing 10 identically with the arrangement of the high-pressure electrode H and the low-pressure electrode L.

The lamp housing 10 prevents light-leakage of the visible rays emitted from each of the lamps 12 and reflects the visible rays proceeding to both a side surface and a rear surface of the lamps 12 toward the diffusion plate 14 to thereby improve light efficiency of the lamps 12.

The diffusion plate 14 makes the light emitted from the

lamps proceed toward the liquid crystal panel 20 and make the light incident at a wide scope of angle. The diffusion plate 14 includes a transparent resin film having a light diffusion material coated on both sides thereof.

The optical sheets 16 lessen a visual angle of the light emitted from the diffusion plate 16 to thereby improve a brightness of a liquid crystal display and to decrease power consumption.

Since in the LCD adopting the direct-below-type back light of the related art, the high-pressure electrode H and the low-pressure electrode L of the plurality of lamps 12 are identically arranged, the difference of a right/left color sense arises. That is, during manufacturing process of the lamps 12 used in the direct-below-type back light, the difference of the color coordinate (the difference of the color sense) is generated in a length direction in accordance with the length of the lamp.

Explaining this in full detail, as shown in Fig. 3, the manufacturing process of the lamps 12 used in a direct-below-type back light comprises preparing an organic solvent 32 mixed with the phosphors of each of red R, green G, and blue B contained in a vessel 30. And then, a lamp bulb 34 is connected to a vacuum pad 36, and the organic solvent 32 is imbibed in the vessel 30 through the lamp bulb 34 by a vacuum

pressure and the organic solvent 32 is applied to the lamp bulb 34 by vacuum. Accordingly, the organic solvent 32 is coated on inside wall. If the phosphor 38 is coated on the inside wall of the lamp bulb 34, electrodes are installed in both side of an aperture part and sealed to thereby complete a lamp.

Since the phosphor 38 coated on the inside wall of the lamp bulb 34 is applied to the inside wall of the bulb 34 by vacuum pressure, in accordance with the vacuum pressure and the length of the lamp bulb 34, the thickness of the lower part is thicker than that of the upper part. Accordingly, in accordance with the thickness of the phosphor 38 coated on the inside wall of the lamp bulb 34, the difference of the color sense between the high pressure electrode H and the lower pressure electrode L arises. Though the brightness of the back light having the phosphor of BaMgAl10O17: EU2+ (BAM) has a brightness characteristic more than 10% of back light having the phosphor of SCA(Sr, Ba, Ca)10(PO4)Cl2: Eu, since the lamp is manufactured by the manufacturing process as described above, the difference of the right/left color sense according to the length of the lamp is generated excessively. On the other hand, the SCA of the phosphor has a defect that high price of optical sheet or brightness improvement of the panel is required.

[TECHNICAL SUBJECT MATTER TO BE SOLVED BY THE INVENTION]

Accordingly, it is an object of the present invention to provide a back light unit and a liquid crystal display using the same capable of improving brightness characteristic and the difference of the color sense of a liquid crystal display having a direct-below-type back light.

[CONFIGURATION AND OPERATION OF THE INVENTION]

In order to achieve these and other objects of the invention, the back light unit according to an aspect of the present invention includes a lamp housing; and a plurality of lamps respectively having a first electrode and a second electrode and arranged in the lamp housing so that the first and the second electrodes are alternately arranged within one side of the lamp housing.

The back light unit further comprises a diffusion plate arranged on the lamp housing; and an optical sheet arranged on the diffusion plate.

The first electrode and the second electrode are respectively arranged in a zigzag shape.

The first electrode and the second electrode are alternately arranged by N-number (where N is a positive integer more than two) in one side of the lamp housing.

A liquid crystal display comprises a back light unit having a lamp housing, and a plurality of lamps respectively having a first electrode and a second electrode and arranged in the lamp housing so that the first and the second electrodes are alternately disposed in one side of the lamp housing; and a liquid crystal panel arranged on the back light unit and having a plurality of liquid crystal cells arranged in a matrix shape.

In the liquid crystal display, said first electrode and the second electrode are respectively arranged in a zigzag shape.

In the liquid crystal display, said first electrode and the second electrode are alternately arranged by N-number (where N is a positive integer more than two) in one side of the lamp housing.

These and other objects of the invention will be apparent from the following detailed description of the embodiments of the present invention with reference to the accompanying drawings, in which:

Hereinafter, the embodiment of the present invention is in detail explained with reference to Fig. 4 to Fig. 9.

Referring to Fig. 4, a back light unit 102 according to the embodiment of the present invention includes a plurality of lamps 112 generating light, a lamp housing 110 (or lamp

container of direct-below-type back light unit 102) located at a lower part of the lamps 112, a diffusion plate 114 located at an upper part of the lamps 112, and optical sheets 116 located on the diffusion plate 114.

Each of the lamps 112 is comprised of a glass tube, an inert gas in the glass tube, a cathode and an anode respectively installed at each ending part of the glass tube. The inert gas is filled up inside the glass tube, and a phosphor is coated at the inner wall of the glass tube.

In the lamps 112, if AC voltage from the inverter (not shown) is applied to a high-pressure electrode (or a first envelope part H) and a low-pressure electrode (or a second envelope part L), electrons are emitted from the low-pressure electrode L and are collided with the inert gas in the glass tube whereby the quantity of electrons is increased exponentially. The current flows in the glass tube by the increased electrons and thus the inert gas is exited to emit ultraviolet rays. The ultraviolet rays are collided with the phosphor and mercury coated at an inner wall of the glass tube to thereby emit visible rays.

The lamps 112 are arranged in parallel on the lamp housing 110. As shown in Fig. 5, the lamps 112 are arranged on the lamp housing 110 so that the arrangement of the high pressure electrode H and low pressure electrode L is repeated.

That is, each of odd-numbered (or even-numbered) lamps of the lamps 112, the high voltage electrode H is at its right side and each of even-numbered (or odd-numbered) lamps of the lamps 112 has the low voltage electrode L at its right side. In other words, in the lamps 112, each of the high pressure electrode H and the low pressure electrode L is disposed in a zigzag shape.

The lamp housing 110 serves to prevent light-leakage of the visible rays emitted from each of the lamps 112 and to reflect the visible rays proceeding to a side surface and a rear surface of the lamps 112 toward diffusion plate 114 to thereby improve light efficiency of the lamps 112.

The diffusion plate 114 functions to proceed the light emitted from the lamps 112 toward the liquid crystal panel (not shown) and to make the light incident at wide scope of angle. The diffusion plate 114 includes a transparent resin film having a light diffusion material coated on both sides thereof.

The optical sheets 116 decrease a visual angle of the light emitted from the diffusion plate 116 to thereby improve a brightness of a liquid crystal display and to decrease power consumption.

Since the back light unit 102 according to the embodiment of the present invention has the lamps 112 in which

the high pressure electrodes H and the low pressure electrodes L are repeated in the lamp housing 110, the difference of the right/left color sense dose not arise. That is, during manufacturing process of the lamps employed in the direct-below-type back light unit 102, the right/left color-coordinate-difference (difference of the color sense) of the lamps arise, by the way, in the present invention, the high pressure electrodes H and the low pressure electrodes L of the lamps 112 are repeatedly disposed to thereby maintain uniform difference of the color sense in the right/left. In other words, for example, if explaining left part of the lamp housing 110 shown in Fig.5, since the lamps 112 are disposed in sequence of a low pressure electrode L, a high pressure electrode H, a low pressure electrode L, a high pressure electrode H, …, the difference of the color sense is offset by adjacent low pressure electrode L and high pressure electrode H to become uniform.

The difference of the right/left difference of the color sense of the back light unit 102 according to the embodiment of the present invention can be expressed by Equation 1 as below.

【Equation 1】

The difference of right/left difference of the color sense ($\triangle uv$) = $((u_1-u_2)^2 + (v_1-v_2)^2)^{1/2}$

where $u = 4x/(3+12y-2x)$

$v = (2/3) \times (9y)/(3+12y-2x)$

In Equation 1, x and y are color coordinates, u_1 is max u, v_1 is max v, u_2 is min u, and v_2 is min v. By using Equation 1, the difference of the color sense Δuv is calculated by measuring chromaticity coordinates (defined in Commission International De L' Eclairage (CIE)) at an arbitrary point when the lamps 112 are driven. In Equation 1, u_1 and v_1 have maximum values of color-coordinates measured at the arbitrary point respectively, and u_2 and v_2 are minimum value of color-coordinates measured at the arbitrary point, respectively. When right/left difference of the color sense Δuv is below 0.004 as calculated by Equation 1, the right/left difference of the color sense phenomenon of the lamps 112 dose not arise.

In conjunction with Fig. 6, the brightness distribution of the back light unit 102 according to the embodiment of the present invention and the brightness distribution of the back light unit according to the related art are compared as follows. As shown in Fig. 6, the brightness distribution of the back light unit 102 having the arrangement of zigzag fashion are more than that of related art in which a plurality of lamps of electrodes have same arrangement structure. That is, at the arbitrary point, since the brightness of the present invention is higher than that of the related art at

each arbitrary point, the total brightness of the present invention is improved as compared with the related art.

Fig. 7A and Fig. 7B represents tables that the right/left difference of the color sense Δuv is calculated by using the color coordinate (x,y) measured value at arbitrary seventeen points shown in Fig. 6. The right/left difference of the color sense Δuv of the related art becomes 0.0097 and the right/left difference of the color sense Δuv of the present invention becomes 0.0028. Accordingly, while the right/left difference of the color sense arises in the back light unit of the related art, the right/left difference of the color sense phenomenon of the back light unit 102 of the present invention dose not arise since the right/left color-sense-difference Δuv is below 0.004.

Accordingly, the electrodes of the lamps 112 are arranged in a zigzag form in the lamp housing and the back light unit 102 of the present invention in which minimizes the right/left difference of the color sense to thereby improve picture quality and to increase brightness of BAM (or SAC) phosphor.

On the other hand, as shown in Fig. 8, the back light unit of the present invention includes a plurality of lamps 112 in which the low pressure electrodes L and the high pressure electrodes H are arranged alternately by n-number

(where n is a positive integer more than two) in one side of the lamp housing 110.

A plurality of lamps 112 arranged in parallel on the lamp housing 110 have the electrodes repeatedly disposed with the sequence of the high pressure electrode H and the low pressure electrode L, the high pressure electrode H and the low pressure electrode L, the low pressure electrode L and the high pressure electrode H, the low pressure electrode L and the high pressure electrode H and so on. In other words, since the electrodes of the lamp arranged in left side of the lamp housing 110 are arranged with a sequence of the low pressure electrode L, the low pressure electrode L, the high pressure electrode H, the high pressure electrode H, the low pressure electrode L, the low pressure electrode L… and so on, the difference of the color sense is offset by the low pressure electrode L and the high pressure electrode H adjacent with each other to evenly maintain right/left difference of the color sense.

Referring to Fig. 9, there is shown a liquid crystal display using the back light unit 202 of the present invention which includes a liquid crystal panel for displaying pictures 220 and a back light unit for radiating uniform light to the liquid crystal panel 220.

The liquid crystal cells are arranged in active matrix

between upper and lower substrates 223 and 224 of the liquid crystal panel 220. A pixel electrode and a common electrode for applying electric field are installed for each liquid crystal cell. In general, while the pixel electrode is formed for each liquid crystal cell on the lower substrate 224, that is, on a thin film transistor substrate, the common electrode is formed on whole surface of the upper substrate 222. The pixel electrode is connected to the thin film transistor used as a switching device. The pixel electrode drives the liquid crystal cell along with the common electrode in accordance with video data signal supplied through the thin film transistor to thereby display pictures corresponding to the video signal.

A back light unit 202 includes a plurality of lamps 212 generating light, a lamp housing 210 located in the lower part of the lamps 212, a diffusion plate 214 located in the upper part of the lamps 212, and optical sheets 216 located on the diffusion plate 214.

Each of the lamps 212 includes a glass tube, an inert gas in the glass tube, and a cathode and an anode installed at ending parts of the glass tube respectively. The inert gas is filled up in the glass tube, and a phosphor is coated at the inner wall of the glass tube.

If AC voltage from the inverter (not shown) is applied

to a high-pressure electrode and a low-pressure electrode in each of the lamps 212, electrons are emitted from the low-pressure electrode L and are collided with the inert gas in the glass tube to thereby increase the quantity of electrons. The current flows in the glass tube by the increased electrons and thus the inert gas is exited by electrons to emit ultraviolet rays. The ultraviolet rays are collided with the phosphor and mercury coated to the inner wall of the glass tube to thereby emit visible rays.

The lamps 212 are arranged in parallel on the lamp housing 210. As shown in Fig. 5, the lamps 212 are arranged on the lamp housing 210 so that the arrangement of a high pressure electrode H and a low pressure electrode L is repeated. That is, each of odd-numbered (or even-numbered) lamps of the lamps 212 has the high voltage electrode H at its right side, and each of the even-numbered (or odd-numbered) lamps of the lamps 212 has the low voltage electrode L at its right side. In other words, in the lamps 212, each of the high pressure electrode H and the low pressure electrode L is arranged in a zigzag shape.

The lamp housing 210 serves to prevent light-leakage of the visible rays emitted from each of the lamps 212 and to reflect the visible rays proceeding to a side surface and a rear surface of the lamps 212 toward diffusion plate 214 to

thereby improve light efficiency of the lamps 212.

The diffusion plate 214 functions to proceed the light emitted from the lamps 212 toward the liquid crystal panel (not shown) and to make the light incident at wide scope of angle. The diffusion plate 214 includes a transparent resin film having a light diffusion material coated on both sides thereof.

The optical sheets 216 lessen a visual angle of the light emitted from the diffusion plate 214 to thereby improve a brightness of a liquid crystal display and to decrease power consumption.

Since the liquid crystal display using the back light unit according to the embodiment of the present invention has the lamps 212 in which the high pressure electrodes H and the low pressure electrodes L are repeated on the lamp housing 210, the difference of the right/left color sense dose not arise. That is, during manufacturing process of the lamps employed in the direct-below-type back light unit 202, the difference of the right/left color coordinate (the difference of the color sense) of the lamps arise. However the high pressure electrodes H and the low pressure electrodes L of the lamps 212 of the invention are repeatedly disposed to thereby evenly maintain the difference of the right/left color sense. In other words, for example, if explaining left part of the lamp

housing 210 shown in Fig. 5, since the electrodes of the lamps 212 are arranged in a sequence of a low pressure electrode L, a high pressure electrode H, a low pressure electrode L, a high pressure electrode H, and so on, the difference of the color sense is offset by adjacent low pressure electrode L and high pressure electrode H to thereby maintain the difference of the color sense. On the other hand, the lamps on the lamp housing 210 are disposed so that electrodes of adjacent lamps are arranged with different electrodes for each of at least two lamps. That is, the lamps disposed in parallel on the lamp housing 210 have the electrodes repeatedly arranged with a sequence of the high pressure electrode H and the low pressure electrode L, the high pressure electrode H and the low pressure electrode L, the low pressure electrode L and the high pressure electrode H, the low pressure electrode L and the high pressure electrode H... and so on. In other words, since the electrodes of the lamps arranged in left side of the lamp housing 210 are arranged with the sequence of the low pressure electrode L, the low pressure electrode L, the high pressure electrode H, the high pressure electrode H, the low pressure electrode L, the low pressure electrode L, the difference of the color sense is offset by adjacent low pressure electrode L and high pressure electrode H to evenly maintain the difference of the right/left color sense.

Accordingly, the liquid crystal display using the back light unit 202 according to the embodiment of the present invention improves the brightness and minimizes the right/left difference of the color sense to thereby improve the picture quality.

[EFFECT OF THE INVENTION]

As described above, the back light unit and the liquid crystal display using the same according to the embodiment of the present invention arranges the lamps to have the arrangement of the high pressure electrode and the low pressure electrode in a zigzag form or the arrangement of the high pressure electrode and the low pressure electrode different with each other for each of at least two lamps. Accordingly, the present invention improves the brightness and minimizes the right/left difference of the color sense to thereby improve the picture quality.

Although the present invention has been explained by the embodiments shown in the drawings described above, it should be understood to the ordinary skilled person in the art that the invention is not limited to the embodiments, but rather that various changes or modifications thereof are possible without departing from the spirit of the invention. Accordingly, the scope of the invention shall be determined

only by the appended claims and their equivalents.

What is claimed is:

1. A back light unit, comprising:

a lamp housing; and

a plurality of lamps respectively having a first electrode and a second electrode and arranged in the lamp housing so that the first and the second electrodes are alternately arranged within one side of the lamp housing.

2. The back light unit as claimed in claim 1, further comprises:

a diffusion plate arranged on the lamp housing; and

an optical sheet arranged on the diffusion plate.

3. The back light unit as claimed in claim 1, wherein said first electrode and the second electrode are respectively arranged in a zigzag shape.

4. The back light unit as claimed in claim 1, wherein said first electrode and the second electrode are alternately arranged by N-number (where N is a positive integer more than two) in one side of the lamp housing.

5. A liquid crystal display, comprising:

a back light unit having a lamp housing, and a plurality of lamps respectively having a first electrode and a second electrode and arranged in the lamp housing so that the first and the second electrodes are alternately disposed in one side of the lamp housing; and

a liquid crystal panel arranged on the back light unit and having a plurality of liquid crystal cells arranged in a matrix shape.

6. The liquid crystal display as claimed in claim 5, wherein said first electrode and the second electrode are respectively arranged in a zigzag shape.

7. The liquid crystal display as claimed in claim 5, wherein said first electrode and the second electrode are alternately arranged by N-number (where N is a positive integer more than two) in one side of the lamp housing.